Acta Universitatis Danubius
Œconomica

Financial Economics

Food Price, Oil Price and Exchange Rate Dynamics in BRICS: Panel VAR and Dynamic Panel Threshold Analyses

Kazeem Abimbola Sanusi[1], Zandri Dickason-Koekemoer[2]

Abstract: Food price has continued to increase significantly and the oil price continues to be volatile in the midst of a downward trend in the external value of most currencies. This study purposes to shed light on the dynamic interaction between oil prices, exchange rates and food prices in BRICS and investigate the direction of the causality. The study also aims at determining the existence of an oil price threshold on the oil price and food price nexus. In order to achieve the objectives of the study, panel VAR and dynamic threshold models were employed using monthly data from January 2003 to March 2022. The findings show that oil prices and exchange rate shocks exert a significant influence on food prices. Our findings also show that oil prices and exchange rates are significant sources of variations in food prices. The findings confirm the existence of unidirectional causality from oil price to food price, and from exchange rate to food price. This study also establishes the existence of an oil price threshold on the nexus between oil price and food price. It can be recommended that the implementation of sound macroeconomic policies in the oil sectors keep the domestic oil price below the threshold level.

Keywords: Russia; Ukraine; price; food

JEL Classification: Q18

1. Introduction

The aftermath impacts of the war between Russia and Ukraine are not only restricted to the two countries but have been globally felt. The external supply of commodities that these countries export has been disrupted and interrupted, thereby worsening the risk of global food insecurity already ravaging many countries (World Bank, 2022). Russia is the world's biggest exporter of commodities like wheat and crude oil

[1] North West University, South Africa, Address: Private Bag X1290, Potchefstroom 2520, South Africa, E-mail: sanusikazeemabimbola@yahoo.com.
[2] North West University, South Africa, Address: Private Bag X1290, Potchefstroom 2520, South Africa, Corresponding author: Zandri.Dickason@nwu.ac.za.

amongst many other commodities. More than 50 countries are said to be dependent on Russia and Ukraine for more than 30 percent of wheat importation, while more than 36 countries receive about 50 percent of their wheat from Russia and Ukraine. Similarly, Russia significantly contributes to the global economy and it's one of the top three producers of crude oil in the world. Fillis et al. (2011) claim that wars in the world can lead to surges in oil prices and unsteadiness in global business cycles. As stated by Nasir, et al. (2018), oil is a significant commodity in the trade industry with varying impacts on various economic variables. Li and Guo (2022) further emphasise that oil is an important industrial raw material with prices that play an important role in the price of production, household incomes, expenditure of consumers, employment rate and economic growth. Oil prices have been rising as a result of war and the spillover effects have been undesirable on the supply of food and consequently on the food prices generally. For instance, Dole (2022) argued that a ten-percent rise in oil prices is expected to worsen inflation by 40 basis points in India and depreciate the rupee.

BRICS like other countries have been exposed to the twirling of global oil markets since most members heavily depend on oil importation to meet a significant portion of their oil needs. For instance, Nasir, et al. (2018), oil and petroleum products are the most imported products in BRICS countries, and they are the second most exported products.

The macroeconomic dynamics of food price and the oil price has been argued to depend upon whether the economy is a developed or developing economy or the economy is a net exporter or importer of commodities and oil. Javed et al. (2019) argued that increased oil prices lead to lower economic activities and increased inflation rates in oil-importing countries because oil is an important direct input production process. It is believed that an oil price increase impacts food prices negatively (Alghalith, 2010). Meanwhile, increased food prices, on the other hand, could also negatively affect the economy and could impact negatively on oil prices through the exchange rate, particularly for a food-importing economy (Alom, Ward & Hu, 2013). Though there have been substantial studies on the relationship between oil prices and food prices, on one hand, and the relationship between oil prices and exchange rates on another hand. However, empirical studies on dynamic interactions between food price, oil price and exchange rate are still very lean. This is particularly important because food price and oil price impacts are transmitted through the exchange rate. Zmami and Ben-Salha (2019) concluded that there exists a long-term link between food prices and the prices of oil. Similarly, Esmaeli & Shokoohi (2010) claim that the relationship between prices of crude oil and food was indirect between 1961 and 2005. Additionally, Meyer et al. (2018) discovered that oil prices only positively impact food prices when they increase in the long run. In the same vein, Roman, et al., (2020), argued that there exists a long-run positive relationship between prices of meat and crude oil prices from 1990 to 2020. On the other hand, Vo et al. (2019) argued that not every shock to oil prices affects food prices. This empirical finding is consistent with Fowowe (2016). Food prices and oil prices have been increasing sources of inflation in BRICS (Holtemöller & Mallick, 2016; Anand, Ding, & Tulin, 2014). On the other hand, the dynamic relationship between oil price and exchange rate fluctuation has been extensively documented in the literature (Sanusi & Kapingura, 2022; Sanusi, 2020; Bénassy-Quéré et al., 2007; Coudert et al., 2007; Buetzer et al., 2016). For instance, Turhan et al. (2013) investigated the impacts of oil prices on the exchange rates in selected economies. They concluded that shocks to oil price lead reduction in the value of the exchange rates. The conclusion is consistent with some other empirical studies on the oil price and exchange rate nexus (Buetzer et al., 2016, Ahmed et al., 2016; Jiranyakul, 2015). Consequently, the exchange rate is seen as a means via which effects of changes in the oil price are transmitted into real sectors such as food prices. Hence, empirical study on the dynamics between the food price, oil price and the exchange rate is particularly germane as it will shed light on the dynamics of linkages between oil price, food price and exchange rate in the light of current upward movements in food price. Rezitis (2015) investigates the relationship between crude oil prices, US dollar exchange rates and agricultural commodity prices using a panel analysis. The empirical results show that both crude oil prices and exchange rates affect agricultural commodity prices. Rezitis (2015) also finds evidence of bidirectional panel causality between crude oil prices and agricultural commodity prices on one hand, and between exchange rates and agricultural commodity prices. Almalki et al (2022) investigate the impacts of structural oil shocks on food prices in Saudi Arabia using nonlinear autoregressive distributed lags (NARDL) and Structural Vector Autoregressive (S-VAR). Empirical findings suggest that a significant relationship between negative shocks in crude oil prices and food prices was found in the short and long run. The study reveals that increases in oil supply result in a decline in food prices decrease in both periods. Ijeoma et al. (2016) determine the long and short-run relationships between oil price and food price volatility and the causal link in Nigeria using VECM. Empirical findings suggest the presence of a positive and significant short-run relationship between oil price and food price volatility while evidence of unidirectional causality is found from oil price to food price volatility. This study contributes to the discussion by examining the dynamic relationship between food prices, oil prices and exchange rates in BRICS countries using a panel VAR analysis. The role of exchange movement on food prices cannot be ignored. This is because the BRICS economies are interdependent with a lot of importations and exportation among them. The study also contributes by investigating the dynamic impact of the exchange rate on food prices. On the other hand, the divergent empirical submissions on the oil and food prices nexus could be a result of the existence of a threshold. This idea is further substantiated by Youssef and Mokni (2021) who argued that the impact of oil prices on food prices is regime-dependent. Furthermore, these authors stated that the response of food prices to different structural oil shocks depends on the regime of the oil price. Consequently, the current study also contributes to the literature by investigating the possibility of a threshold on the impact of oil prices on food prices. Hence, the current study also contributes to the literature by adopting the panel threshold model to investigate the existence of the oil price threshold on the impact of oil prices on food prices in BRICS.

2. Empirical Review

The current global sharp increase in food prices as occasioned by the Russian and Ukrainian war, and amidst the economic challenges imposed on the global economy by the Covid-19 pandemic has provoked further empirical investigations on the nexus between oil and food prices. Hence, different empirical approaches have been deployed to shed light on the relationship between the variables. Theoretically, two channels have been identified as means by which the effects of oil prices are transmitted into food prices The first identified channel is the food production channel. By this, the production of agricultural commodities into the final products consumes a lot of energy, and hence, the increased oil prices are easily transmittable. On the other hand, increased demand for biofuel and edible oils has increased the links between the agricultural market and the energy market (Reboredo, 2012). Almalki et al (2022) argued that an increase in oil prices would impact negatively food prices through the transportation cost of agricultural commodities. The implication is that an increase in oil prices significantly affects the energy-intensive agricultural inputs and hence food prices rise. Zmami and Ben-Salha (2019) examine the impacts of oil prices on world food prices using monthly data from January 1990 and October 2017 employing linear and nonlinear autoregressive nonlinear distributive lag (ARDL). Their findings suggest that overall food price is only affected by positive shocks in oil prices in the long run. The empirical submission also suggests the possibility of an asymmetric relationship between oil prices and food prices. Hanson et al., (1991) investigate the impacts of shocks to global oil prices on the economy of the USA, using a CGE model. As argued by the authors, oil prices affect commodity prices not only through the identified channels but also via exchange rates. Similarly, Meyer et al (2018) explore the impacts of oil price changes on food prices using a non-linear panel autoregressive distributed lag (ARDL) model. They observe the presence of a significant positive relationship between oil prices and food prices in the long run. This is consistent with earlier findings of Abdlaziz et al., (2016). They also submit that there exists a long-run and short-run cointegration between oil prices and food prices.

The frequency domain Granger causality test was employed by Kratschell and Schmidt (2017) to investigate the short- and long-run relationships between oil and food prices. They submit that there is the existence of long-run Granger causality. Evidence of short-run Granger causality was also established. Ijeoma et al. (2016)

investigate the effect of oil prices on the volatility of food prices in Nigeria using a VAR econometric approach. The empirical result shows a positive and significant short-run relationship between oil prices and food prices. Evidence of unidirectional causality from oil price to food price was also established. This is consistent with the findings of Gogoi (2014) and Abdel and Arshad (2008). This is however inconsistent with Alvalos (2014) as this author could not establish any evidence of causality from oil price to food price.

While there exist ample empirical studies confirming the existence of long-run positive relationships between oil and food prices, there are other several other empirical studies suggesting the absence of any impact or marginal impact of oil prices on food prices. For instance, Yu et al. (2008) argued that oil price shocks do not exert any significant effects on edible oil prices. This finding is consistent with the findings of Zhang and Reed (2008). These authors examine the relationship between oil prices and agricultural prices and concluded that oil prices have an insignificant impact on agricultural commodity prices. Lambert and Miljkovic (2010) established an insignificant impact of oil prices on agricultural produces in United State. In the same vein, Nazioglu (2011) examined the linkages between the global oil price and agricultural commodities prices from 1994 to 2010. The findings suggest that there is no relationship between global oil prices and prices of agricultural commodities. This is consistent with Nazioglu and Soytas (2012) that stated agricultural prices do not significantly respond to movement in oil prices and exchange rate shocks in the short-run.

Similarly, Esmaeili and Shokoohi (2011) could not find any evidence of a long-run relationship between oil prices and agricultural commodity prices. Yu, Bessler, and Fuller (2006) investigate the long-run association between crude oil prices and food prices. They found that crude oil price does not affect oil prices. Empirical review shows that studies on the nexus between oil prices and food prices are far from being settled. As a result, this study contributes to the discussion by looking at the dynamic relationship between oil prices, food prices and exchange rates in BRICS economies. Also, the study contributes by looking at the dynamic impact of the exchange rate on food prices. This is particularly relevant because the BRICS are interdependent with one another largely in terms of importation and exportation. So, exchange rate movement is expected to play a role in price level determination, especially the food price.

3. Empirical Methods

The empirical investigation is based on the Panel Vector Autoregression (VAR) model and dynamic panel threshold. Panel VAR is particularly useful for investigating the dynamic relationship among macroeconomic variables. In Panel VAR analysis, all the variables are assumed to be endogenously determined and a cross-sectional element is added to the representation. Panel VARs have been adopted in the literature to generate average effects across heterogeneous panel units and to investigate the unit-specific differences relative to the average. P-VAR models are also useful to investigate a variety of transmission subjects across individual panel units that cannot be captured in simple VAR analysis.

Following Abrigo and Love (2016), the following k-variate homogeneous panel VAR model of order p, with the panel-specific fixed effects is specified:

$$Y_{it} = Y_{it-1}A_1 + Y_{it-2}A_2 + Y_{it-3}A_3 + \cdots + Y_{it-p+1}A_{p-1} + Y_{it-p}A_p + u_{it} \quad (1)$$

$$u_{it} \sim \left(0, \sigma_i^2\right)$$

For i= 1,………., N t= 1,……….,T

Where $Y_t = (1\ X\ 3)$, and is a vector of endogenous variables, namely food prices, oil prices and exchange rates. u_{it} are a vector of dependent variable-specific panel fixed effects and idiosyncratic errors. The $(3\ X\ 3)$ matrices $A_1, A_2,\ A_3$ …… A_{p-1}, A_p are parameters to be estimated. The disturbance term is assumed to have the following characteristics: $E(u_{it}) = 0$,

$E\left(u_{it}^{'}u_{it}\right)$=∑, and $E\left(u_{it}^{'}u_{is}\right) = 0$ for all values of $t > s$. Note that the coefficients of our model are allowed to vary over time; second, the dynamic relationships are allowed to be unit-specific; and third, dynamic feedback across units is possible and this allows for cross-unit lagged interdependencies. Also, following Holtz-Eakin, Newey, and Rosen (1988), it is assumed that the cross-sectional units share the same underlying data-generating process, with the reduced-form parameters.

The dynamic Panel Threshold model

The panel model threshold model is stated as follows.

$$y_{it} = x_{it}^{'}\beta + \left(1,\ x_{it}^{'}\right)\delta 1\,\{q_{it} > \gamma\} + u_i + \ \varepsilon_{it}, \quad (2)$$

$i = 1 \ldots \ldots, n, t = 1 \ldots \ldots, T$

Where q_{it} is the threshold variable. T is fixed and the sample size might become infinite. The dynamic interactions between food prices, oil prices and exchange rates in Brazil, Russia, India, China and South Africa (BRICS) within the framework of Panel VAR and dynamic panel threshold on the impact of oil price and exchange rate on food price in BRICS are being investigated. The data used in this study consist of monthly observations from January 2003 to March 2022. Food price data for each country was obtained from the Food and Agricultural Organisation database (FAO) whilst oil price data were obtained from Index Mundi. Data on the exchange rate was obtained from the Apex Bank of each country.

4. Empirical Findings

The movements of all the variables are depicted in Figures 1 to 5. Oil price and exchange rate variables depict both increasing and decreasing trends throughout the study. Oil prices particularly displayed a high fluctuating trend in each of the countries. However, food price has been consistently and steadily increasing over the study period except for China. Food prices are seen to be relatively stable in China until 2020 when sharp upward movement is observed in food prices. This particular period captured two important shocks, the Covid-19 pandemic, and the Russian and Ukraine war in the global economy. These explained why the upward trend in food prices was much higher in each of the countries around this period. Also, Table 2 shows the panel unit root test result, the unit root tests (LLC, IPS, ADF and PP) indicate that all the variables under investigation are stationary at level. Hence, we estimate P-VAR.

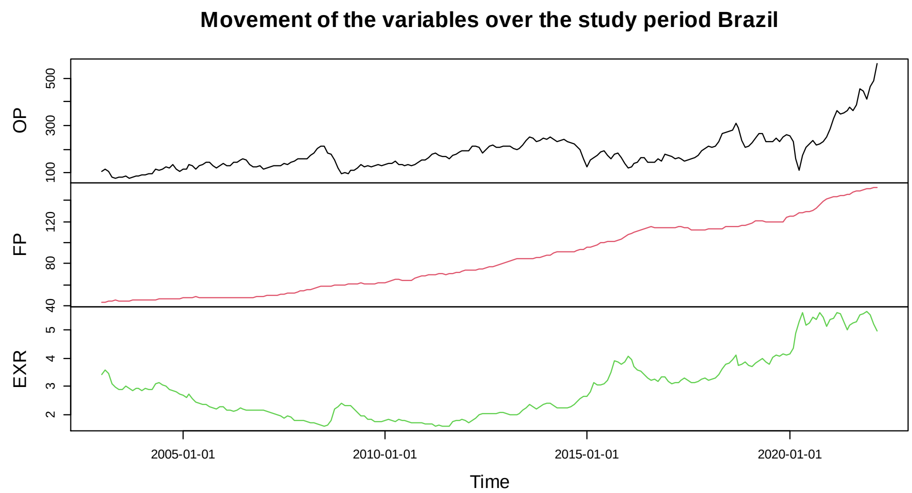

Figure 1. Graphical Presentation of the Variables in Brazil

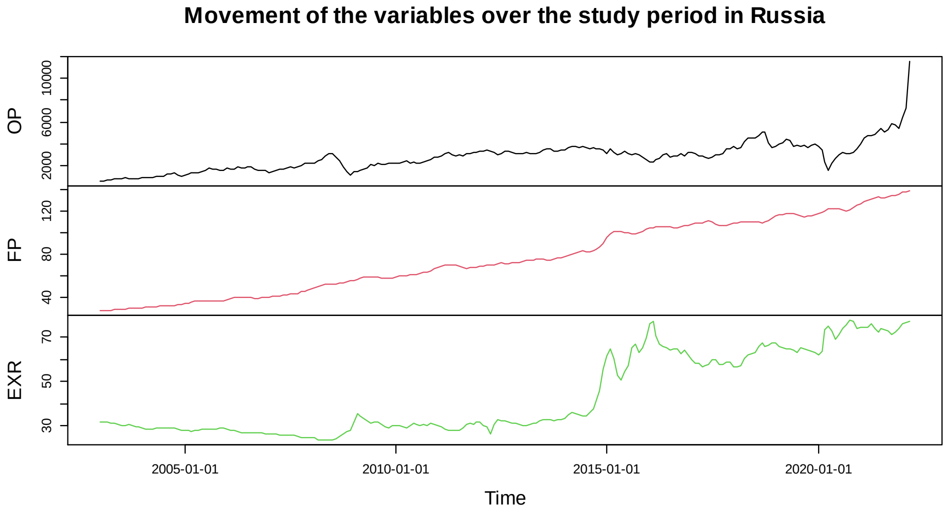

Figure 2. Graphical Presentation of the Variables in Russia

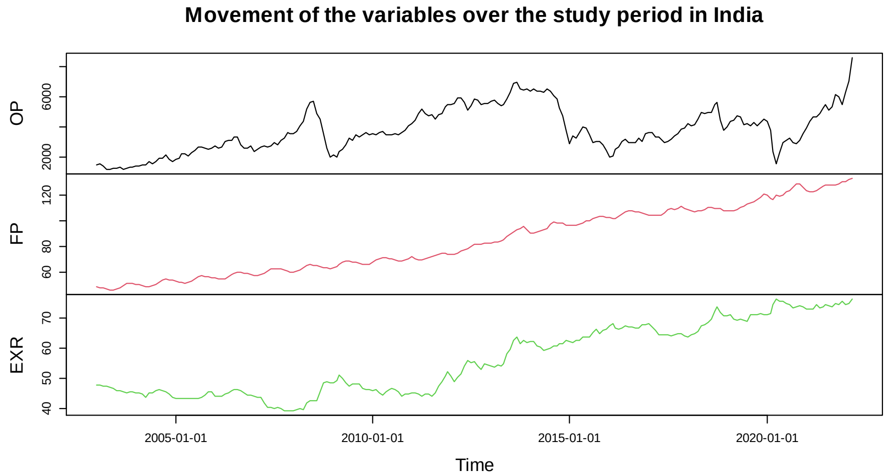

Figure 3. Graphical presentation of the variables in India

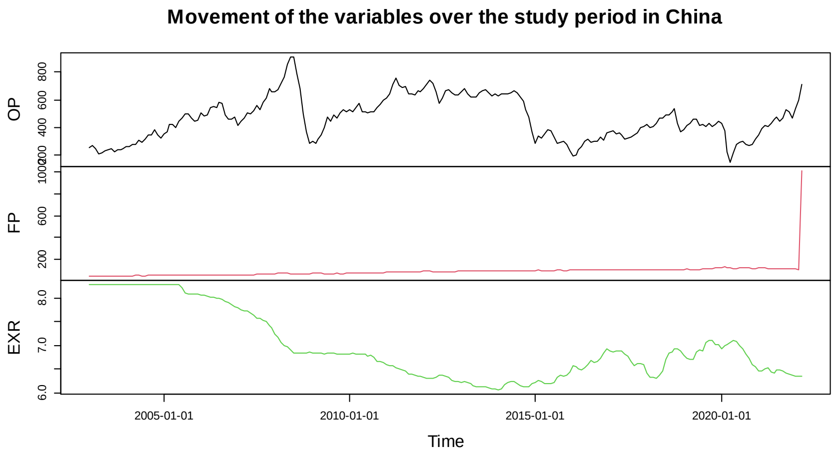

Figure 4. Graphical Presentation of the Variables in China

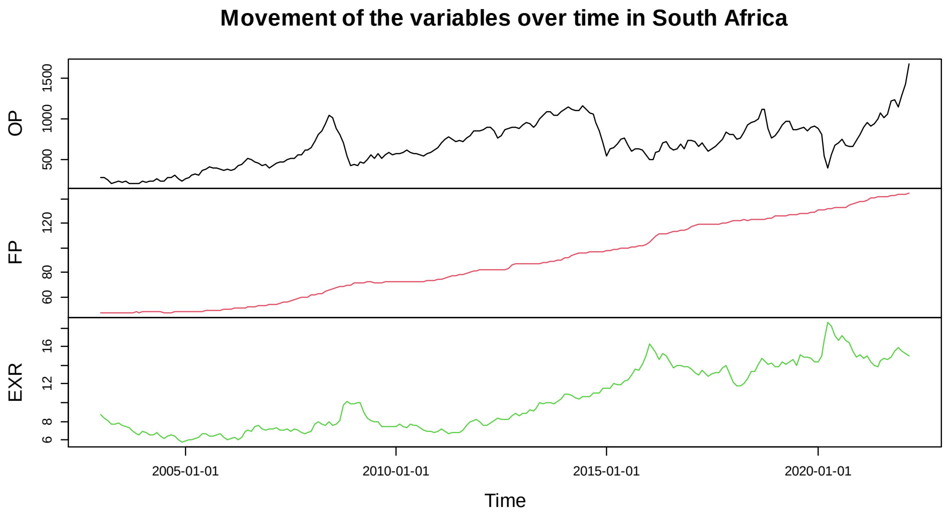

Figure 5. Graphical Presentation of the Variables in South Africa

Table 1. Panel Unit Root Tests

Variable	Level	LLC	P-v	IPS	P-v	ADF	P-v	PP	P-v
FP	0	479	0.00*	-4.66	0.00*	318	0.00*	193	0.00*
	1	-315	0.00*	-73.4	0.00*	274	0.00*	386	0.00*
OP	0	-3.11	0.00*	0.73	0.00*	27.8	0.00*	29.1	0.00*
	1	-3.52	0.00*	-8.17	0.00*	155	0.00*	203	0.00*
EXR	0	-0.21	0.00*	0.29	0.00*	41.2	0.00*	45.8	0.00*
	1	-9.43	0.00*	-10.44	0.00*	202	0.00*	450	0.00*

* represents 1% level of significance, while P-v indicates the probability value

4.2. BVAR Lag Length Selection Criteria

Analysis of Panel VAR is based on choosing the optimal lag order in the specification of panel VAR and moment condition. MMSC for GMM models was proposed by Andrews and Lu (2001) and is precipitated by the work of Hansen (1982). The proposed MMSC are the same as the traditional maximum likelihood-based model-selection criteria, which are the Akaike information criteria (AIC), the Bayesian information criteria (BIC) and the Hannan–Quinn information criteria (HQIC).

Table 2 shows the result of lag selection results for the Panel VAR model. From Table 2, the appropriate lag order is one. This is because according to Andrews and Lu (2001), the first-order panel VAR is chosen because it has the smallest MBIC, MAIC, and MQIC.

Table 2. BVAR Lag Selection Order Criteria

Lag	**CD**	J	J pvalue	MBIC	MAIC	MQIC
1	0.9580	14.6132	0.24713	-52.547*	-4.6185*	-18.0413*
2	0.9830	21.2782	0.04201	-29.7123	3.2182	-9.6311
3	0.9646	6.5492	.0621083	-15.9122	0.9954	-5.6706
4	0.9663	-	-	-	-	-

*Notes: * indicates lag order selected by the criterion*
Source: Authors' computation

4.3. Impulse Response Analysis

The impulse response is obtained from the Panel VAR estimation. The impulse response is used to investigate the dynamic interactions between food price, oil price and exchange in BRICKS. The impulse response graph is presented in Figure 3.

4.3.1. Response of the Variables to Food Price Shocks

The impulse response analysis shows the response of food price to its shock. It shows that shocks to food prices lead to a sharp upward movement in food prices. In other words, food prices sharply rose in response to their shock before the shock effects begin to fall, and eventually dissipate. Also, oil price and exchange rate are observed to slightly oscillate within the positive region and negative. By implication, we observe that oil price and exchange rate slightly respond to food price by insignificantly fluctuating between the positive and negative regions before it eventually fades away.

4.3.2 Response of the Variables to Oil Price Shocks

The impulse response analysis shows that a positive shock to oil prices expectedly has an appreciable and significant impact on food prices. Oil price shock is observed to leave a more lasting impact on food prices. The response is however observed to oscillate largely between the positive and negative regions. Also, though oil price sharply responds to their shocks the shocks is however very short as the effects rapidly fell and eventually faded away. On the other hand, a positive shock to oil prices is discovered to generate a negative response from the exchange rate. By implication, the exchange rate negatively responds to oil price shocks. This is not surprising as it has already been argued that most of the effects of oil price shocks are transmitted through the exchange rate.

4.3.3. Response of the Variables to Exchange Rate Shocks

A positive shock to the exchange rate causes an upward response in food prices, and the effect is observed to take a while before it significantly but not entirely fades away. This is not unexpected as these economies are so interdependent, and significant importation and exportation take place among the members. Also, a positive shock to the exchange rate has a significant and lasting impact on the oil price. Oil price responds greatly and sharply to exchange rate, and the effects of the shocks are observed to last very much longer on the oil price. The exchange rate can be observed to positively respond to the shocks.

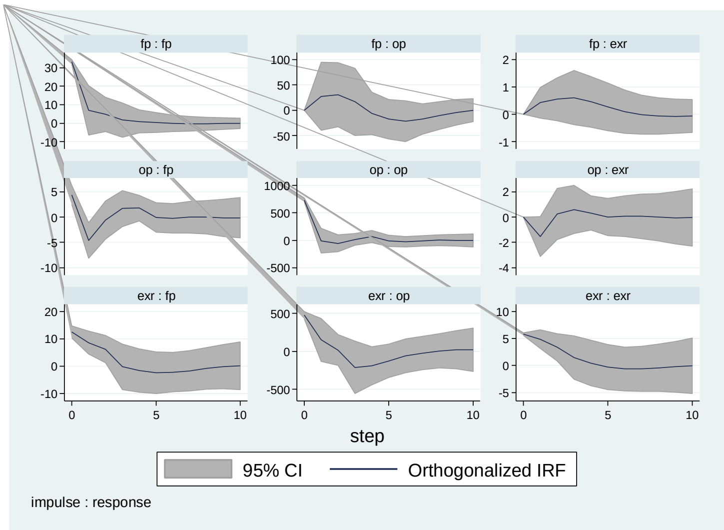

Figure 6. Impulse Response Graph

4.4. Forecast Error Variance Decomposition

Forecast error variance decomposition (FEVD) divides the changes or the variation in an endogenous variable into the component shocks of the Panel VAR model. By implication, variance decomposition provides information about each random innovation's relative importance affecting the variables in the Panel VAR model. This means that FEVD provides information about the dominant or predominant sources of variation in each of the variables in the Panel VAR model. Existing empirical results on FEVD show that the predominant sources of variation in each of the variables are the "own" disturbances or shocks, and our empirical findings follow suit. The FEVD result is contained in Table 3. The empirical findings show that the exchange rate and oil prices are significant sources of variation in food prices in BRICS. More specifically, the oil price is seen to account for more than 15 percent variations in oil price in the early period. The oil price impacts or contribution to variation in food price increased in subsequent periods to as high as 31 percent. This affirms that oil price individually plays a significant role in the variation of food prices. Also, the exchange rate is observed to account for about 19 percent variation in food prices during the period under investigation. On the other hand, the exchange rate is observed to be a significant source of variation in oil prices. The exchange rate accounts for more than 35 percent variation in oil price for most of the time horizons. Finally, the oil price is found to account for about 3 percent variation in the exchange rate.

Table 3. Forecast Error Variance Decomposition Results

	Response Variable=Food Price			Response Variable=Oil Price		Response Variable =Exchange Rate		
	EXR FP		OP	EXR FP	OP	EXR FP		OP
0	0	0	0	0	0	0	0	0
1	0.1231		0.1520	0		1	0	0
2	0.8615			0.2966	0.7034	0.9573		0.0397
3	0.1630		0.2878	0.0000		0.0029		
4	0.8082			0.3167	0.6823	0.9592		0.0342
5	0.1821		0.2782	0.0090		0.0066		
6	0.7900			0.3153	0.6826	0.9510		0.0377
7	0.1815		0.2968	0.0021		0.0112		
8	0.7888			0.3509	0.6468	0.9472		0.0389
9	0.1825		0.3171	0.0023		0.0139		
10	0.7857			0.3756	0.6221	0.9462		0.0388
	0.1856		0.3159	0.0023		0.0149		
	0.7828			0.3862	0.6112	0.9464		0.0387
	0.1881		0.3153	0.0026		0.0149		
	0.7803			0.3879	0.6089	0.9467		0.0385
	0.1897		0.3147	0.0031		0.0148		
	0.7788			0.3880	0.6085	0.9467		0.0384
	0.1901		0.3145	0.0034		0.0149		
	0.7844			0.3880	0.6084	0.9467		0.0384
	0.1901		0.3146	0.0035		0.0149		
	0.7784			0.3884	0.6081			
				0.0035				

4.5. Panel VAR-Granger Causality Wald Test Result

The results of the Panel VAR-Granger causality Wald test result are contained in Table 4. The results show that there exists a unidirectional causality from oil price to food price. In other words, the oil price is found to granger cause food prices in BRICS. Also, a unidirectional causality is observed from exchange to food price. This also means that the exchange rate is found to granger cause food prices.

Table 5. Panel VAR-Granger Causality Wald Test Result

Hypothesis	Chi^2	P-value	conclusion
OP ⟶ FP	29.5	0.000	causality exists
EXR ⟶ FP	47.3	0.000	causality exists
EXR ⟶ OP	40.2	0.000	causality exists
OP ⟶ EXR	35.7	0.000	causality exists
FP ⟶ EXR	1.23	0.744	no causality
FP ⟶ OP	2.682	0.442	no causality

4.6. Dynamic Panel Threshold Results

We discover a nonlinear relationship between food prices and oil prices from BRICS economies over the study period. The oil price threshold is approximately 305.21 at a 1 percent level of significance. Oil price significantly worsens food price when it exceeds the threshold level.

Table 6. Dynamic Panel Threshold Result

FP	Coefficient	St. Error	Probability value
0P_b	-10.8568	8.730	0.214
EXR_b	3.9928	5.981	0.504
Kink_slope	10.874	8.739	0.213
R	305.21	134.75	0.002

4.7. Discussion of Results

From the empirical analysis, exchange rate shocks and oil price shocks are seen to provoke significant responses from food prices. Food price positively responds to oil price shocks and exchange rate shocks. This is not unexpected as oil has been observed to be an important material in the production process, with its price exerting a significant influence on food prices and prices of other items. This finding is consistent with some other empirical findings in the literature such as Li and Guo (2022), Dole (2022), Turhan et al. (2013) and Alghalith (2010) among others. By implication, shocks that impacted exchange rates have negative impacts on the BRICS economies during the period under investigation. This is, however, inconsistent with studies such as Yu et al., (2008), Zhang and Reed (2008) and Lambert and Miljkovic (2010) among others. These studies found that oil prices do not have any significant effects on food prices. In confirmation with findings from impulse response analysis, forecast error variance decomposition shows that oil price is a dominant source of variation in food price. As a matter of fact, it is found to account for more than 30 percent variation in food prices. While the exchange is also found to account for more than 15 percent variation in food price. Similarly, the panel Granger causality test reveals that there exists unidirectional causality running from oil price to food price, and from exchange rate to food price. This is consistent with the findings of Nazioglu (2011), Gogoi (2014) and Abdel and Arshad (2008) as these authors also established the existence of causal relation between oil price and food price, and not the vice visa. However, this is not corresponding with the findings of Avalos (2014) as this author could not find any causal relation between food price and oil price. The dynamic threshold panel results established the existence of an oil price threshold on the oil and food prices relations. The existence of a threshold might be responsible for divergent empirical findings on oil prices and food prices.

5. Conclusion

The main purpose of this study was to investigate the dynamic interaction between oil price, exchange rate and food price in BRICS economies and also to determine the direction of the causal dynamics between oil price, food price and exchange rate. Also, this study investigated the oil price threshold of the oil price and food price nexus. Using monthly data on oil price, food price and exchange rate from January 2003 to March 2022, the study made use of panel VAR model investigations of the dynamic interaction between food price, oil price and exchange rate. The panel unit roots test shows that all the variables are stationary at level, and hence panel VAR model was fitted at the level of the variables. Impulse response analysis from the fitted panel VAR model shows that the shocks to oil prices are significantly felt by food prices in the selected economies. By implication, oil price shock is found to exert significant weight on food prices. This is also the case with the exchange rate as exchange rate shocks are also found to provoke a significant response from the exchange rate. The responses of oil price and exchange rate to food price shocks are found to be highly negligible. In other words, food prices could not exert any significant influence on oil prices and exchange rates. This finding is supported by the forecast error variance decomposition affirms oil price as an important source of variation in food price as it accounts for more than 31 percent variation in food price. Similarly, this study confirms that the exchange rate is a predominant source of variation in food price as it also accounts for more than 15 percent variation in food price. Interestingly, the panel causality test confirms the empirical submissions. Evidence of causality from oil price to food price is established. Also, evidence was found of unidirectional causality from exchange rate to food price. Moreover, bidirectional causality between food prices and oil prices was established. In other words, both oil prices and food prices are found to granger cause each other. Amid divergent views on the impacts of oil prices on food prices as noted from the empirical review, this study looked at the existence if any, of an oil price threshold on the relation between oil price and food price. Our findings establish the existence of an oil price threshold on the oil price and food price nexus. Since most of the BRICS are oil importers, this paper concluded that there must be increased efforts to boost the domestic production of food items in order to reduce the impact of global oil price increases on imported food items. Also, there must be increased efforts at developing alternative sources of energy, as to reduce the negative influence of oil prices on food prices. Sound macroeconomic policies to ensure the stability of currencies should also be implemented to prevent erratic fluctuation of the exchange rate which has a negative impact on food prices.

References

Abdel, H. A. & Arshad, F. M. (2008). The impact of petroleum prices on vegetable oils prices: evidence from cointegration tests. *International Borneo Business Conference on Global Changes, Malaysia*, pp. 15-17.

Abdlaziz, R. A.; Rahim, K. A. & Adamu, P. (2016). Oil and food prices co-integration nexus for Indonesia: A non-linear autoregressive distributed lag analysis. *International Journal of Energy Economics and Policy*, 6(1), pp. 82-87.

Abrigo, M. R. & Love, I. (2016). Estimation of panel vector autoregression in Stata. *The Stata Journal*, 16(3), pp. 778-804.

Ahmed, R.; Qaiser, I. & Yaseen, M. R. (2016). Nexus between exchange rate volatility and oil price fluctuations: Evidence from Pakistan. *Pakistan journal of Commerce and Social Sciences*, 10(1), pp. 122-148.

Alghalith, M. (2010). The interaction between food prices and oil prices. *Energy Economics*, 32(6), pp. 1520-1522.

Almalki, A. M.; Hassan, M. U. & Amin, M. F. B. (2022). The asymmetric relationship between structural oil shocks and food prices: evidence from Saudi Arabia. *Applied Economics*, pp. 1-18.

Alom, F.; Ward, B. D. & Hu, B. (2013). Macroeconomic effects of world oil and food price shocks in A sia and Pacific economies: application of SVAR models. *OPEC Energy Review*, 37(3), pp. 327-372.

Avalos, F. (2014). Do oil prices drive food prices? The tale of a structural break. *Journal of International Money and Finance*, 42, pp. 253-271.

Anand, R.; Ding, D. & Tulin, M. V. (2014). *Food inflation in India: The role for monetary policy*. International Monetary Fund.

Bénassy-Quéré, A.; Mignon, V. & Penot, A. (2007). China and the relationship between the oil price and the dollar. *Energy policy*, 35(11), pp. 5795-5805.

Buetzer, S.; Habib, M. M. & Stracca, L. (2016). Global exchange rate configurations: Do oil shocksmatter? *IMF Economic Review*, 64(3), pp. 443-470.

Coudert, V.; Mignon, V. & Penot, A. (2007). Oil price and the dollar. *Energy Studies Review*, *15*(2).

Dole, M. S. (2022). Russia-Ukraine war: Impact on Indian Economy. *IJNRD-International Journal of Novel Research and Development (IJNRD)*, 7(4), pp. 303-309.

Esmaeili, A. & Shokoohi, Z. (2011). Assessing the effect of oil price on world food prices: Application of principal component analysis. *Energy Policy*, 39(2), pp. 1022-1025.

Filis, G., Degiannakis, S., & Floros, C. (2011). Dynamic correlation between stock market and oil prices: The case of oil-importing and oil-exporting countries. *International review of financial analysis*, 20(3), pp. 152-164.

Fowowe, B. (2016). Do oil prices drive agricultural commodity prices? Evidence from South Africa. *Energy*, 104, pp. 149-157.

Gogoi, A. B. H. I. S. H. E. K. (2014). Investigating the long run relationship between crude oil and food commodity prices. *Doctoral dissertation, MSc thesis*. Department of Economics, University of Nottingham, Nottingham).

Hanson, K.; Robinson, S. & Schluter, G. (1991). *Sectoral effects of a world oil-price shock: economy-wide linkages to the agricultural sector. Staff report* (No. PB-92-128610/XAB; AGES-91-56). Economic Research Service, Washington, DC (United States). Agriculture and Rural Economy Div..

Holtz-Eakin, D.; Newey, W. & Rosen, H. S. (1988). Estimating vector autoregressions with panel data. *Econometrica: Journal of the econometric society*, pp. 1371-1395.

Holtemöller, O. & Mallick, S. (2016). Global food prices and monetary policy in an emerging market economy: The case of India. *Journal of Asian Economics*, 46, pp. 56-70.

Ijeoma, F.; Okogbe, B. & Orimoloye, S. (2016, August). Challenges of Drilling Deep Set Surface Casing Strings in Orogho, Ovhor and Oben Fields. In *SPE Nigeria Annual International Conference and Exhibition*. OnePetro.

Javed, F.; Aslam, M.; Rashid, N.; Shamair, Z.; Khan, A. L.; Yasin, M. & Bazmi, A. A. (2019). Microalgae-based biofuels, resource recovery and wastewater treatment: a pathway towards sustainable biorefinery. *Fuel*, *255*, 115826.

Jiranyakul, K. (2015). Oil price volatility and real effective exchange rate: the case of Thailand. *International Journal of Energy Economics and Policy*, 5(2), pp. 574-579.

Krätschell, K. & Schmidt, T. (2017). Long-run waves or short-run fluctuations–what establishes the correlation between oil and food prices?. *Applied Economics*, *49*(54), pp. 5535-5546.

Lambert, D. K. & Miljkovic, D. (2010). The sources of variability in US food prices. *Journal of Policy Modeling*, 32(2), pp. 210-222.

Li, Y. & Guo, J. (2022). The asymmetric impacts of oil price and shocks on inflation in BRICS: a multiple threshold nonlinear ARDL model. *Applied Economics*, 54(12), pp. 1377-1395.

Meyer, D. F.; Sanusi, K. A. & Hassan, A. (2018). Analysis of the asymmetric impacts of oil prices on food prices in oil-exporting, developing countries. *Journal of International Studies*, *11*(3).

Nasir, M. A.; Naidoo, L.; Shahbaz, M., & Amoo, N. (2018). Implications of oil prices shocks for the major emerging economies: A comparative analysis of BRICS. *Energy Economics*, *76*, pp. 76-88.

Nazlioglu, S. (2011). World oil and agricultural commodity prices: Evidence from nonlinear causality. *Energy policy*, 39(5), pp. 2935-2943.

Nazlioglu, S. & Soytas, U. (2012). Oil price, agricultural commodity prices, and the dollar: A panel cointegration and causality analysis. *Energy Economics*, 34(4), pp. 1098-1104.

Reboredo, J. C. (2012). Modelling oil price and exchange rate co-movements. *Journal of Policy Modeling*, 34(3), pp. 419-440.

Rezitis, A. N. (2015). The relationship between agricultural commodity prices, crude oil prices and US dollar exchange rates: A panel VAR approach and causality analysis. *International Review of Applied Economics*, 29(3), pp. 403-434.

Roman, Monika; Górecka, Aleksandra & Domagała, Joanna (2020). The linkages between crude oil and food prices. *Energies*, p. 6545.

Sanusi, K. A. & Kapingura, F. M. (2022). On the relationship between oil price, exchange rate and stock market performance in South Africa: Further evidence from time-varying and regime switching approaches. *Cogent Economics & Finance*, 10(1), 2106629.

Sanusi, K. A. (2020). Oil prices asymmetric and exchange rate volatility: Case of oil-exporting emerging countries. *Journal of International Studies*, *13*(4), pp. 101-109.

Turhan, I.; Hacihasanoglu, E. & Soytas, U. (2013). Oil prices and emerging market exchange rates. *Emerging Markets Finance and Trade*, *49*(sup1), pp. 21-36.

Youssef, M. & Mokni, K. (2021). On the Nonlinear Impact of Oil Price Shocks on the World Food Prices Under Different Markets Conditions. *International Economic Journal*, 35(1), pp. 73-95.

Yu, L.; Wang, S. & Lai, K. K. (2008). Forecasting crude oil price with an EMD-based neural network ensemble learning paradigm. *Energy economics*, 30(5), pp. 2623-2635.

Yu, T. H. E.; Bessler, D. A. & Fuller, S. W. (2006). *Cointegration and causality analysis of world vegetable oil and crude oil prices* (No. 379-2016-21814).

Zhang, Q., & Reed, M. R. (2008). *Examining the impact of the world crude oil price on China's agricultural commodity prices: the case of corn, soybean, and pork* (No. 1368-2016-108438).

Zhang, Y. J. & Wei, Y. M. (2010). The crude oil market and the gold market: Evidence for cointegration, causality and price discovery. *Resources Policy*, 35(3), pp. 168-177.

Zmami, M. & Ben-Salha, O. (2019). Does oil price drive world food prices? Evidence from linear and nonlinear ARDL modeling. *Economies*, *7*(1), p. 12.